

Candium Lab

Name: _____

Period: _____

Background:

Isotopes are atoms of the same element with the same atomic number (number of protons) but different masses due to different numbers of neutrons in the nuclei. The atomic mass of an element is the weighted average of the masses of the different isotopes. The weighted average takes into account both the masses of the isotopes and their relative (percent) abundance of each isotope as it occurs in nature. Therefore the most abundant isotope contributes the most to the overall atomic mass of the element. In the laboratory, an instrument called a mass spectrometer can measure the mass of each isotope and can determine the relative abundances of each isotope in a sample of an element.

Because we do not have a mass spectrometer and because knowing how to do a weighted average is a skill to acquire, today you are going to be the mass spectrometers. During this lab you will carefully measure and record data which will enable you to perform the calculations to determine the atomic mass of the fictitious element Candium.

There are three isotopes of Candium - M&Mium, Skittlitium, and Reeces Piecium. In this model each piece of candy represents an atom. You will obtain a sample of Candium and determine the relative abundance and mass of each isotope in your sample. As in real elements, these isotopes each have different masses. Unlike real elements each atom of a given isotope does not have the same mass as other atoms of the same isotope. Therefore you have to determine the average mass of one atom of each isotope of Candium.

Safety:

Before obtaining your sample, WASH YOUR HANDS! Obtain a clean piece of paper towel to place your Candium sample on.

Procedure:

- Do not dispose/eat any of your sample of Candium atoms until your teacher has given you permission!!
- Separate out all of your atoms by isotope. M&Ms have an M, Skittles have an S and Reeces Pieces are not marked.
- Count all the atoms of each isotope and record the numbers in your data table.
- Determine the total number of atoms in your sample.
- Determine the mass of all the atoms for each type of isotope separately and record the three masses in the data table.

Data and Analysis Table:

| | M&Mium | Skittleitium | Reeces Piecium | Total |
|---|---------|--------------|----------------|------------|
| Total number of atoms | | | | |
| Total mass of Atoms | | | | XXXXXXXXXX |
| Average mass of one atom | | | | XXXXXXXXXX |
| Relative abundance (%) | | | | 100.0% |
| Relative mass | | | | XXXXXXXXXX |
| Weighted average atomic mass of Candium | XXXXXXX | XXXXXXXXX | XXXXXXXXXXX | |
| Class Average | | | | |

Calculations for Data Table:

- 1.) Determine the average mass of one atom for each isotope by dividing the total mass of each isotope by the total number of each isotope. Enter in data table
- 2.) Determine the relative abundance of each isotope by dividing the number of each isotope by the total number of atoms in the sample.
- 3.) Determine the relative mass of each isotope by multiplying the relative abundance for each isotope by the average mass for each isotope. (Don't forget to convert the abundance percentage to decimal equivalent)
- 4.) Determine the weighted average mass of Candium by adding the relative masses for each isotope.
- 5.) Write your weighted average atomic mass for Candium on the board.

Conclusions, Questions and Applications:

- 1.) Write a formula for each of the steps listed in calculations section.

Example: Avg. mass of one atom = $\frac{\text{total mass of all atoms of an isotope}}{\text{total number of atoms of that isotope}}$

Relative Abundance =

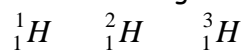
Relative Mass =

Average mass =

- 2.) Give **two** reasons why there are different values for the weighted average atomic mass of Candium in the class.
- 3.) In your own words what does weighted average mean?
- 4.) Give two examples outside chemistry where weighted average could/should be used instead of a simple average.

5.) Why are atomic masses on the periodic table not whole numbers?

6.) How are the following isotopes of hydrogen alike? Different?



7.) Copper has two isotopes, Copper - 63 (${}^{63}_{29}\text{Cu}$) and Copper - 65 (${}^{65}_{29}\text{Cu}$). The relative abundance of Cu-63 is 69.1%. What is the weighted average atomic mass of Copper? (Assume the mass of Cu-63 is 63.000 amu and the mass of Cu-65 is 65.000 amu).

8.) In a sack of marbles there are red marbles each weighing 11.50g and green marbles which each weighing 12.70g. There are 10,051 red marbles and 24,351 green marbles. Determine the mass of the average marble in the sack. (Explain why the answer is not equal to $(11.50 + 12.70)/2 = 12.10\text{g}$.)

9.) Only two isotopes of Boron occur in nature. One isotope is well known: Boron - 11 with a relative abundance of 80.39%. If the weighted average atomic mass of the element Boron is 10.811 amu, what is the mass of one atom of the other isotope?